COMPUTATIONAL STUDY OF TORTOUSITY OF PACKED LUNAR REGOLITH FOR ISRU TRANSPORT MODELS. G. L. Schieber[1], J. Yarrington[1], B. M. Jones[2], T. M. Orlando[2], P. G. Loutzenhiser[1], [1]George W. Woodruff School of Mechanical Engineering and [2]School of Chemistry and Biochemistry, Georgia Institute of Technology

Introduction: Tortuosity is an important parameter in determining the transport rates of gases through porous media, particularly for the lunar environment [1]. Tortuosity accounts for the non-uniform, non-straight flow channels that develop through porous media. Tortuosity is simply the total path length that a gas molecule follows over the length that it has traveled within a porous medium. Consequently, tortuosity must be greater than one due to the inherent non straight flow channels that develop within a porous medium. Tortuosity, is difficult to measure, requiring either complex experimental apparatuses or the submersion of the sample in water [2, 3]. A fully realized computational model for tortuosity would allow for the rapid determination of tortuosity based on the particle properties of the porous medium, allowing for prediction of gas transport within it. This work considers the development of such a model.

Model approach: A computational model for tortuosity, known as the path tracking method, has been developed for spherical particles [4]. This method serves as the building block to develop a more complex method to determine tortuosity for non-spherical particles with a particle size distribution. The model consists of two parts, (1) the simulation of particle packing computationally, (2) the path tracking algorithm. The simulation of the particle packing for this work is accomplished with the open source particle simulation software, LIGGGHTS [5]. The modified path tracking method is accomplished with MATLAB.

Results: Preliminary results have been obtained. The LIGGGHTS simulation technique is able to produce packed beds at different conditions rapidly and will allow for model fits to be developed. The modified path tracking method is a work in progress, with preliminary results close to experimental data. Figure 1 shows a sample run, with uniform spherical, particles 6 mm in diameter and cylindrical bed dimensions of 9 cm in diameter and 30 cm in length. The bed porosity is 0.380. The predicted tortuosity is 1.27.

Future work: This study shows potential of the path tracking method in determining the tortuosity of the porous medium formed by Lunar regolith. The path tracking algorithm for determining tortuosity is coupled to the LIGGGHTS open source particle simulation software, and will be utilized to predict the tortuosity of packed Lunar regolith. The path tracking method must be modified to account for the non-spherical, non-uniform regolith particles. If realized the modified path tracking method could be used to develop correlations for the tortuosity of Lunar materials and allow of the prediction of gas transport.

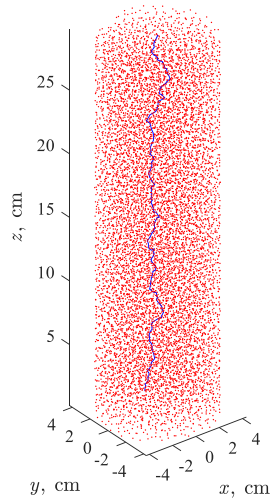

Figure 1: Sample run of the path tracking code (blue line) mapped in 3 dimensions. Particle centroids are mapped (red dots). Simulation utilized 10,464 6mm diameter particles.

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